CLAIMS

1. An injection method for injecting a two-pack urethane foam composition and injecting or filling a urethane foam obtained by foaming and curing the two-pack urethane foam composition, wherein:

(i) a shut-off plate for an injection port is mounted on the inner side of a structural body to be injected and filled so as to open or close the injection port;

(ii) a rubber-formed member having a cut portion capable of being inserted so as to open or close the injection port is inserted into the injection port; or

(iii) a check valve that allows a fluid to pass only in a one direction is mounted on the injection port;

in order to prevent the two-pack urethane foam composition once injected from leaking and expanding by a back flow.

2. A two-pack urethane foam composition for forming a urethane foam by reaction in the presence of a foaming agent, comprising:

(a) a polyol compound as a major component; and

(b) a polyisocyanate compound as a curing agent;

wherein:

the major component (a) is formulated with an amine compound having at least one of an amino ($-NH_2$) group and an imino (-NH-) group and an average molecular weight of 110 or more; and

the foaming agent is adjusted to allow the amino ($-NH_2$) group and/or the imino (-NH-) group of the amine compound to amount to from 0.05 to 3% by weight with

respect to the total amount of the major component (a) and the curing agent (b) and to allow the resulting urethane foam to have a specific gravity in the range of 0.6 to 0.01.

3. The two-pack urethane foam composition as claimed in claim 2, wherein the amine compound to be formulated with the major component (a) is selected from the group consisting of an aliphatic amine, an aromatic amine, an aliphatic amine having an aromatic ring, and an alicyclic amine.

4. The two-pack urethane foam composition as claimed in claim 2 or 3, wherein the foaming agent is one or a mixture of two or more selected from water and a chemically foaming agent of a thermally decomposable type.

5. The two-pack urethane foam composition as claimed in any one of claims 2 to 4, wherein the urethane foam is formed as an injected and foamed material in a pillar having a closed sectional structure of the body of a vehicle including an automobile.

6. A cured urethane foam-filled vehicle body member having a two-pack urethane foam composition injected and filled in the inside of the closed sectional portion of a vehicle body member having a closed sectional structure and having a cured urethane foam injected and filled therein by foaming and curing the two-pack urethane foam composition; wherein a cured urethane foam-filling confirming opening having an opening size of 10 mm or smaller is disposed on this side by 50 mm or shorter from a limit position in

which the cured urethane foam eventually reaches, in order to confirm the appropriateness of a filling volume of the cured urethane foam in accordance with the volume of the inside of the closed sectional structure of the vehicle body member.

7. The cured urethane foam-filled vehicle body member as claimed in claim 6, wherein the two-pack urethane foam composition comprises a polyol compound as a major component and a polyisocyanate compound as a curing agent and the major component is formulated with a foaming agent.

8. The cured urethane foam-filled vehicle body member as claimed in any one of claim 6 or 7, wherein the cured urethane foam-filling confirming opening having an opening size of 1-7.5 mm is disposed on this side by 30 mm or shorter from the limit position in which the cured urethane foam eventually reaches.

9. An injecting method for injecting a cured urethane foam by injecting a two-pack urethane foam composition in the inside of the closed sectional portion of a vehicle body member having a closed sectional structure and foaming and curing the two-pack urethane foam composition to form the cured urethane foam, wherein a cured urethane foam-filling confirming opening having an opening size of 10 mm or smaller is disposed on this side by 50 mm or shorter from a limit position in which the cured urethane foam eventually reaches; and the appropriateness of a filling volume of the cured urethane foam in accordance with the volume of the inside of the closed sectional structure of

the vehicle body member is confirmed.

10. The injecting method as claimed in claim 9, wherein the cured urethane foam-filling confirming opening having an opening size of 1-7.5 mm is disposed on this side by 30 mm or shorter from the limit position in which the cured urethane foam eventually reaches.

11. A cured urethane foam-filling confirming method for confirming the appropriateness of a filling volume of a cured urethane foam in the inside of the closed sectional portion of a vehicle body member having a closed sectional structure upon injecting a two-pack urethane foam composition in the inside of the closed sectional structure thereof and injecting and filling the resulting urethane foam obtained by foaming and curing the two-pack urethane foam composition therein, wherein temperature on a side surface of the closed sectional structure thereof is measured from outside in a non-contact way; and the appropriateness of the filling volume of the cured urethane foam thereof with respect to the volume of the inside of the closed sectional structure thereof is confirmed by a filled site and a non-filled site of the closed sectional structure thereof on the basis of a temperature difference between the filled site and the non-filled site of the closed sectional structure thereof.

12. The cured urethane foam-filling confirming method as claimed in claim 11, wherein the temperature difference is 10°C or larger.

13. The cured urethane foam-filling confirming method as

claimed in claim 11 or 12, wherein the temperature is measured with an infrared thermal image device or an infrared radiation thermometer.

14. An injection process for injecting a two-pack urethane foam composition in the inside of the closed sectional portion of a vehicle body member having a closed sectional structure and injecting and filling therein the cured urethane foam obtained by foaming and curing the two-pack urethane foam composition, wherein the two-pack urethane foam composition is mixed by jetting out the two-pack mixing high-pressure foaming machine in a counter flow under high pressure; and the resulting two-pack urethane foam composition is discharged and injected so as to allow a cream time from injection to be set to three seconds or shorter and a rise time therefrom to be set to 10 to 120 seconds.

15. The injection process as claimed in claim 14, wherein the two-pack urethane foam composition is a foaming material comprising (a) a polyol compound as a major component and (b) a polyisocyanate compound as a curing agent and being capable of forming a urethane foam by reaction in the presence of a foaming agent; and a catalyst is added to the major component (a) so as to adjust the cream time and the rise time to a predetermined time range.

16. The injection process as claimed in claim 14, wherein: the two-pack urethane foam composition is a foaming material comprising (a) the polyol compound as a major component and (b) a polyisocyanate compound as a curing

agent and forming the urethane foam by reaction in the presence of the foaming agent; wherein:

the major component (a) is formulated with an amine compound having at least one of an amino ($-NH_2$) group and an imino (-NH-) group and an average molecular weight of 110 or more; and the amount of the foaming agent is adjusted to allow the amino ($-NH_2$) group and/or the imino (-NH-) group of the amine compound to amount to from 0.05 to 3% by weight with respect to the total amount of the major component (a) and the curing agent (b) and to allow the resulting urethane foam to have a specific gravity in the range of 0.6 to 0.01.

17. The injection process as claimed in any one of claims 14 to 16, wherein the foaming agent is water.

18. An injecting apparatus for injecting and filling a closed sectional structure of a vehicle body, comprising:

a manipulator disposed so as to be movable to a desired position;

a injector fixed to said manipulator;

a supply means for supplying a foaming material to said injector; and

a controller adapted to control the position of said manipulator so that said injector is aligned in a position in which said foaming material can be supplied to said closed sectional structure of the vehicle body through an injection port of said closed sectional structure thereof, and control said supply means so that said foaming material can be injected and filled in said closed sectional

structure thereof by only such an amount that is set in accordance with the volume of the inside of said closed sectional structure thereof.

19. The injecting apparatus as claimed in claim 18, further comprising:

a position detecting sensor for sensing a position of deviation between said injector and said injection port of said closed sectional structure of the vehicle body.

20. The injecting apparatus as claimed in claim 19, wherein:

said position detecting sensor sends said amount of deviation to said controller and adjusts the position of said manipulator so as to make said amount of deviation zero.

21. The injecting apparatus as claimed in claim 20, wherein:

said position detecting sensor is mounted on said manipulator; and

said position detecting sensor comprises an image pickup tube for picking up an image of said injection port of said closed sectional structure of the vehicle body;

a memory section for saving a reference image of said injection port; and

a detecting section for detecting said amount of deviation between an image of said injection port outputted from said image pickup tube and said reference image saved in said memory section.

22. The injecting apparatus as claimed in claim 21,

wherein:

said controller comprises said detecting section.

23. The injecting apparatus as claimed in claim 21, wherein:

said pickup image device is a CCD camera.

24. The injecting apparatus as claimed in claim 18 or 19, further comprising a monitor device for monitoring a foamed state and a cured state of said foaming material in the inside of said closed sectional structure of the vehicle body.

25. The injecting apparatus as claimed in claim 21, further comprising a monitor device for monitoring a foamed state and a cured state of said foaming material in the inside of said closed sectional structure of the vehicle body.

26. The injecting apparatus as claimed in claim 25, wherein:

said monitor device corrects a reference image of said injection port in accordance with the position of a non-filled site of said closed sectional structure of the vehicle body in which the foaming material is not injected and filled, when said monitor device detects said non-filled site.

27. The injecting apparatus as claimed in any one of claims 24 to 26, wherein:

said monitor device comprises an infrared camera for monitoring the foamed state of the foaming material in said closed sectional structure of the vehicle body and a

thermal image unit for converting a signal of the temperature from said infrared camera into a thermal image data and display the resulting thermal image.

28. The injecting apparatus as claimed in claim 24, wherein:

said monitor device is provided with a tapping-type non-destructive examination device for monitoring the filled state in said closed sectional structure of the vehicle body and a device for converting a tapping wave from said tapping-type non-destructive examination device and displaying.

29. The injecting apparatus as claimed in claim 18, wherein:

said closed sectional structure of the vehicle body is a pillar portion of the vehicle body.

30. The injecting apparatus as claimed in claim 18, wherein:

said closed sectional structure of the vehicle body is a locker portion of the vehicle body.

31. A vehicle body-injecting apparatus for reinforcing each of plural vehicle bodies being conveyed in sequence on an automobile assembly line; comprising:

a manipulator disposed in a predetermined working position on said automobile assembly line so as to be movable to a desired position;

a injector mounted on said manipulator;

a supply means for supplying a foaming material to said injector; and

a detecting unit disposed in the position close to said injector for detecting the event that the vehicle body enters into the predetermined working position; and

a controller for controlling the position of said manipulator so that said injector is aligned with the position in which said foaming material is injected and filled in said closed sectional structure of the vehicle body through an injection port of said closed sectional structure thereof, and controlling said supply means so that said foaming material is injected and filled in said closed sectional structure thereof by only such an amount that is set in accordance with the volume of the inside of said closed sectional structure thereof.

32. The vehicle body-injecting apparatus as claimed in claim 31, further comprising:

a position detecting sensor disposed in said manipulator for sensing an amount of deviation between said injector and said injection port of said closed sectional structure of the vehicle body.

33. The vehicle body-injecting apparatus as claimed in claim 32, wherein:

said position detecting sensor inputs said amount of deviation to said controller and adjusts the position of said manipulator so as to make said amount of deviation zero.

34. The vehicle body-injecting apparatus as claimed in claim 33, wherein:

said position detecting sensor comprises an image

pickup tube for picking up an image of said injection port of said closed sectional structure of the vehicle body; a memory section for saving a reference image of said injection port; and a detecting section for sensing said amount of deviation between an image of said injection port outputted from said image pickup tube and said reference image saved in said memory section.

35. The vehicle body-injecting apparatus as claimed in claim 34, wherein:

said controller comprises said detecting section.

36. The vehicle body-injecting apparatus as claimed in claim 31 or 32, further comprising:

a monitor device for monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

37. The vehicle body-injecting apparatus as claimed in claim 34, further comprising:

a monitor device for monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

38. The vehicle body-injecting apparatus as claimed in claim 37, wherein:

said monitor device corrects a reference image of said injection port in accordance with the position of a non-filled site of said closed sectional structure of the vehicle body in which the foaming material is not injected and filled, when said monitor device detects said non-filled site.

39. The vehicle body-injecting apparatus as claimed in any one of claims 36 to 38, wherein:

said monitor device comprises an infrared camera for monitoring the foamed state of the foaming material filled in said closed sectional structure of the vehicle body and a thermal image unit for converting a signal of the temperature from said infrared camera into a thermal image data and display the thermal image.

40. The vehicle body-injecting apparatus as claimed in claim 36, wherein:

said monitor device is provided with a tapping-type non-destructive examination device for monitoring the cured state in said closed sectional structure of the vehicle body and a device for converting a tapping wave from said tapping-type non-destructive examination device and displaying.

41. The injecting apparatus as claimed in claim 31, wherein:

said closed sectional structure of the vehicle body is a pillar portion of the vehicle body.

42. The injecting apparatus as claimed in claim 31, wherein:

said closed sectional structure of the vehicle body is a locker portion of the vehicle body.

43. A injecting method for injecting and filling a foaming material in the closed sectional structure of a vehicle body; comprising:

the step of providing a manipulator movable to a

desired position;

the step of controlling the position of said manipulator so as to align a injector mounted on said manipulator with the position in which said foaming material is supplied to said closed sectional structure of the vehicle body through an injection port of said closed sectional structure thereof;

the step of supplying said foaming material to said closed sectional structure of the vehicle body through said injector in the amount set so as to comply with the volume of said closed sectional structure of the vehicle body; and

the step of foaming and curing said foaming material in said closed sectional structure of the vehicle body.

44. The injecting method as claimed in claim 43, further comprising:

the step of sensing an amount of deviation between said injector and said injection port of said closed sectional structure of the vehicle body.

45. The injecting method as claimed in claim 44, further comprising:

the step of adjusting the position of said manipulator so as to make said amount of deviation zero.

46. The injecting method as claimed in claim 44 or 45, wherein:

the step of sensing said amount of deviation comprises:

the step of saving a reference image of said injection port;

the step of picking up an image of said injection port of said closed sectional structure of the vehicle body; and

the step of detecting said amount of deviation by comparing an image of said injection port picked up above with said reference image saved above.

47. The injecting method as claimed in claim 46, wherein:

said picking up the image is effected by a CCD camera.

48. The injecting method as claimed in claim 43 or 44, further comprising:

the step of monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

49. The injecting method as claimed in claim 46, further comprising:

the step of monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

50. The injecting method as claimed in claim 49, further comprising:

the step of correcting a reference image of said injection port in accordance with the position of a non-filled portion of said closed sectional structure of the vehicle body in which said foaming material is not injected and filled, when said non-filled site is monitored.

51. The injecting method as claimed in any one of claims 48 to 50, wherein:

the step of monitoring comprises the step of detecting the foamed state of said foaming material filled in said

closed sectional structure of the vehicle body with an infrared camera; and the step for converting a signal of the temperature from said infrared camera into a thermal image data.

52. The injecting method as claimed in claim 48, wherein:

the step of monitoring comprises the step of monitoring the cured state in said closed sectional structure of the vehicle body with a tapping-type non-destructive examination device for monitoring; and the step of converting a tapping wave from said tapping-type non-destructive examination device and displaying.

53. The injecting method as claimed in claim 43, wherein:

said closed sectional structure of the vehicle body is a pillar portion of the vehicle body.

54. The injecting method as claimed in claim 43, wherein:

said closed sectional structure of the vehicle body is a locker portion of the vehicle body.

55. A injecting method for filling and reinforcing a closed sectional structure of each of plural vehicle bodies being conveyed in sequence on an automobile assembly line, comprising:

the step of providing a manipulator movable to a desired position in a predetermined working position on said automobile assembly line;

the step of detecting that said vehicle body enters into said predetermined working position;

the step of aligning a injector mounted on said manipulator with an injection port of said closed sectional

structure thereof on the basis of the detection of said vehicle body obtained by the above step and by controlling the position of said manipulator; and

the step of supplying said foaming material to a injecting nozzle in the amount set so as to comply with the volume of said closed sectional structure of the vehicle body.

56. The injecting method as claimed in claim 55, further comprising:

the step of sensing an amount of deviation between said injector and said injection port of said closed sectional structure of the vehicle body.

57. The injecting method as claimed in claim 56, further comprising:

the step of adjusting the position of said manipulator so as to make said amount of deviation zero.

58. The injecting method as claimed in claim 56 or 57, wherein:

the step of sensing said amount of deviation comprises:

the step of saving a reference image of said injection port;

the step of picking up an image of said injection port of said closed sectional structure of the vehicle body; and

the step of detecting said amount of deviation by comparing an image of said injection port picked up above with said reference image saved above.

59. The injecting method as claimed in claim 55 or 56,

further comprising:

the step of monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

60. The injecting method as claimed in claim 58, further comprising:

the step of monitoring a foamed state and a cured state of said foaming material filled in the inside of said closed sectional structure of the vehicle body.

61. The injecting method as claimed in claim 60, further comprising:

the step of correcting a reference image of said injection port in accordance with the position of a non-filled portion of said closed sectional structure of the vehicle body in which said foaming material is not injected and filled, when said non-filled site is monitored..

62. The injecting method as claimed in claim 59, wherein:

the step of monitoring comprises the step of monitoring the cured state in said closed sectional structure of the vehicle body with a tapping-type non-destructive examination device for monitoring; and the step of converting a tapping wave from said tapping-type non-destructive examination device and displaying.

63. The injecting method as claimed in any one of claims 59 to 61, wherein:

the step of monitoring comprises:

the step of detecting the cured state of said foaming material filled in said closed sectional structure of the

vehicle body with an infrared camera; and

the step for converting a signal of the temperature from said infrared camera into a thermal image data.

64. The injecting method as claimed in claim 55, wherein:

said closed sectional structure of the vehicle body is a pillar portion of the vehicle body.

65. The injecting method as claimed in claim 55, wherein:

said closed sectional structure of the vehicle body is a locker portion of the vehicle body.

66. The injecting apparatus as claimed in any one of claims 18 to 30, wherein:

a two-pack urethane foam composition is used as said foaming material.

67. The injecting apparatus as claimed in any one of claims 31 to 43, wherein:

a two-pack urethane foam composition is used as said foaming material.

68. The injecting method as claimed in any one of claims 43 to 54, wherein:

a two-pack urethane foam composition is used as said foaming material.

69. The injecting method as claimed in any one of claims 55 to 65, wherein:

a two-pack urethane foam composition is used as said foaming material.

70. The injecting method as claimed in any one of claims 18 to 30, wherein:

said injector is provided with a discharging and

injecting nozzle; and

said discharging and injecting nozzle is engageable with said injection port when said injector is aligned with said injection port of said closed sectional structure of the vehicle body.

71. The injecting method as claimed in any one of claims 31 to 42, wherein:

said injector is provided with a discharging and injecting nozzle; and

said discharging and injecting nozzle is engageable with said injection port when said injector is aligned with said injection port of said closed sectional structure of the vehicle body.

72. The injecting method as claimed in any one of claims 43 to 54, wherein:

said injector is provided with a discharging and injecting nozzle; and

said discharging and injecting nozzle is engageable with said injection port when said injector is aligned with said injection port of said closed sectional structure of the vehicle body.

73. The injecting method as claimed in any one of claims 55 to 65, wherein:

said injector is provided with a discharging and injecting nozzle; and

said discharging and injecting nozzle is engageable with said injection port when said injector is aligned with said injection port of said closed sectional structure of

the vehicle body.

74. An injecting apparatus for injecting a two-pack urethane foam composition in the closed sectional structure of a vehicle body, said two-pack urethane foam composition comprising:

(a) a polyol compound as a major component; and

(b) a polyisocyanate compound as a curing agent;

wherein the major component (a) is formulated with an amine compound having at least one of an amino ($-NH_2$) group and an imino (-NH-) group and an average molecular weight of 110 or more; and the foaming agent is adjusted to allow the amino ($-NH_2$) group and/or the imino (-NH-) group of the amine compound to amount to from 0.05 to 3% by weight with respect to the total amount of the major component (a) and the curing agent (b) and to allow the resulting urethane foam to have a specific gravity in the range of 0.6 to 0.01; and said injecting apparatus comprising:

a manipulator disposed so as to be movable to a desired position;

a injector fixed to said manipulator;

a supply means for supplying a foaming material to said injector; and

a controller adapted to control the position of said manipulator so that said injector is aligned with the position in which said foaming material can be supplied to said closed sectional structure of the vehicle body through an injection port of said closed sectional structure thereof, and control said supply means so that said foaming

material can be injected and filled in said closed sectional structure thereof by only such an amount that is set in accordance with the volume of the inside of said closed sectional structure thereof.

75. The injecting apparatus as claimed in claim 74, wherein:

upon injecting said two-pack urethane foam composition in the inside of the closed sectional portion of the vehicle body having a closed sectional structure and injecting and filling the resulting urethane foam obtained by foaming and curing said two-pack urethane foam composition, the appropriateness of a filling volume of a cured urethane foam in the inside of the closed sectional structure thereof is confirmed by measuring temperature on a side surface of the closed sectional structure in a non-contact way; and the appropriateness of the filling volume of the cured urethane foam thereof in accordance with the volume of the inside of the closed sectional structure is confirmed by a filled site and a non-filled site of the closed sectional structure thereof on the basis of a temperature difference between the filled site and the non-filled site of the closed sectional structure thereof.

76. The injecting apparatus as claimed in claim 74 or 75, wherein:

upon injecting said two-pack urethane foam composition in the inside of said closed sectional structure of the vehicle body and supplying a cured urethane foam obtained by foaming and curing said two-pack urethane foam

composition, said two-pack urethane foam composition is injected with a two-pack mixing high-pressure foaming machine in a counter flow under high pressure so as to allow a cream time from injection to be set to three seconds or shorter and a rise time therefrom to be set to 10 to 120 seconds.